

## INTRODUCTION

- Exposure to isolated environments has been shown to (1) increase impulsive choices, (2) decrease impulsive action behaviors,<sup>1,2</sup> and (3) impair the adaptability of behavior given changing reward contingencies/values.<sup>3</sup>
  - Behavioral flexibility deficits may explain greater choice impulsivity.
  - Behavioral rigidity may inhibit sampling of other choices in the environment.
- Rats raised in enriched environments (composed of conspecifics and novel objects) are traditionally compared to rats raised in isolated environments (no conspecifics or novel objects),<sup>4</sup> confounding the effects of social and novelty enrichment on impulsivity.
- Goals of the experiment:** (1) Parse out the effects of social and novelty enrichment on two measures of impulsivity and one measure of behavioral flexibility using a 2x2 between-subjects design; (2) Determine the relationship between impulsivity and behavioral flexibility across individual rats.

## METHOD



- Impulsive choice task**
  - Smaller-sooner (SS): 1 pellet in 10 s
  - Larger-later (LL): 1 → 2 → 3 pellet(s) in 30 s
- Behavioral flexibility/set-shifting task**
  - Phase 1:** Visual discrimination
    - Responses reinforced for pressing the lever below an illuminated cue light
  - Phase 2:** Response discrimination
    - Responses reinforced for pressing the lever opposite to the rat's side bias, regardless of the location of the illuminated cue light
- Impulsive action task**
  - Differential-reinforcement-of-low-rate (DRL) with a 30-s criterion

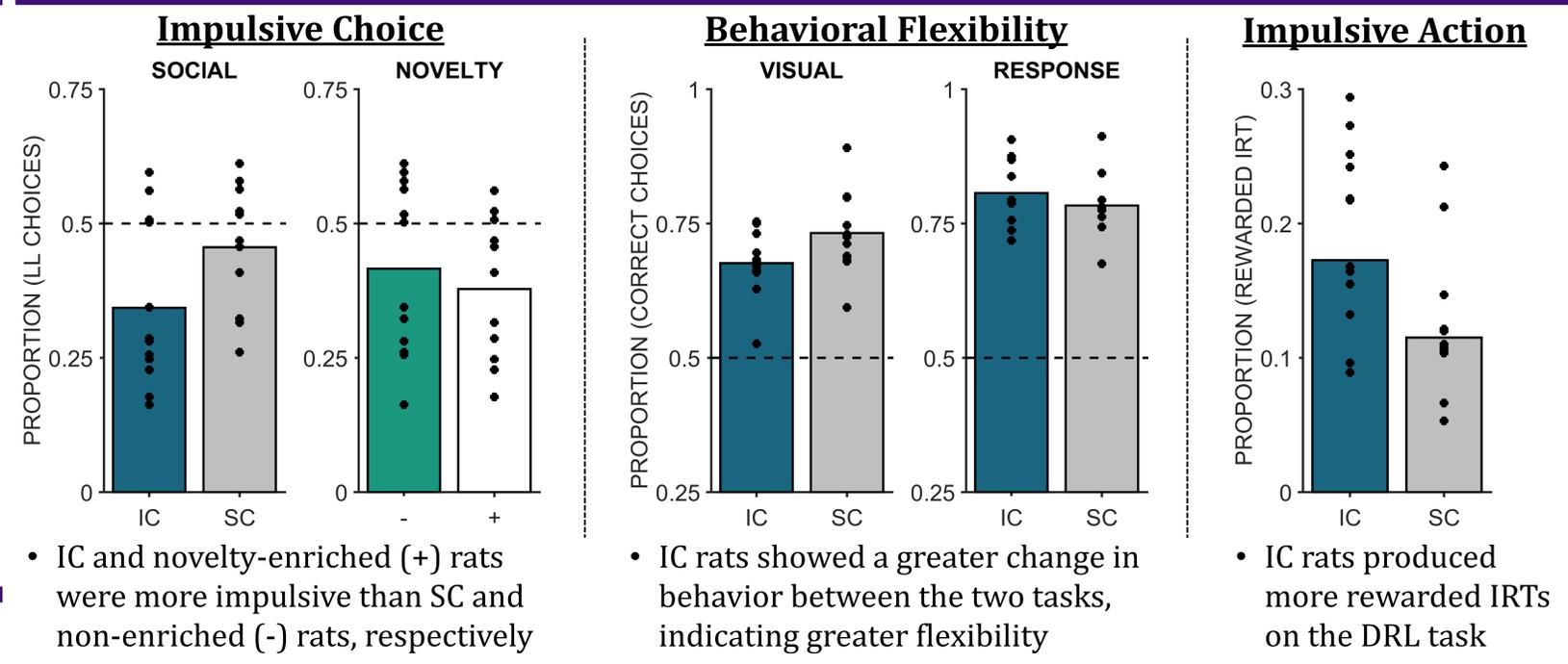
- 24 experimentally-naïve male Sprague-Dawley rats
  - Isolated, no novel objects (IC-)
  - Isolated + novel objects (IC+)
  - Social, no novel objects (SC-)
  - Social + novel objects (SC+)

## DATA ANALYSIS

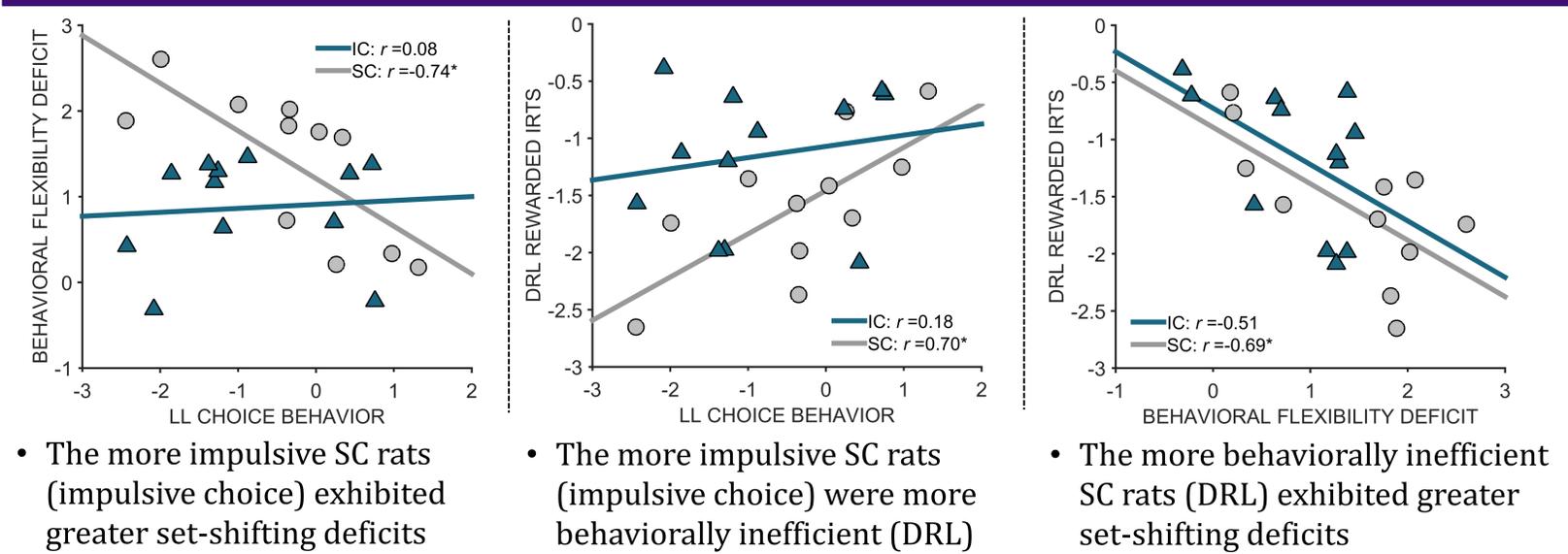
- Generalized linear mixed-effects models**
  - Distribution** = binomial; **Link** = logit
  - Approach:** First, determined best random-effects structure, then best fixed-effects structure, added to random-effects structure
  - Model comparison:** Log-likelihood ratio tests ( $p < .05$ )
- Inter-task correlations**
  - Logit-transformed proportions

Task	Fixed Effects (* = also Random Effect)
Impulsive Choice	Intercept*; Social; Novelty; LL Magnitude*
Behavioral Flexibility	Intercept*; Social × Phase; Novelty × Session; Phase*
Impulsive Action	Intercept*; Social

## RESULTS



## INTER-TASK CORRELATIONS: SOCIAL ENRICHMENT



## DISCUSSION

- Social enrichment reduced impulsive choice and increased impulsive action,<sup>1,2</sup> while novelty enrichment increased impulsive choice.
  - Novelty-induced impulsive choice is consistent with evidence showing that audiovisual overstimulation produces cognitive deficits in mice.<sup>5</sup>
- Elevated behavioral flexibility in IC rats may reflect greater incentive motivation to work for/earn food reward.<sup>1</sup>
- Social enrichment moderated inter-task correlations:
  - Social rearing may have facilitated the appearance of individual differences,<sup>6</sup> producing greater behavioral variability.
- These results confirm that the rearing environment is a critical developmental antecedent for behavior, producing a complex array of effects on impulsive choice, impulsive action, and behavioral flexibility.

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